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Editorial

Coronary heart disease and risk factors in India – On the brink of an epidemic?

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Coronary heart disease (CHD) is a major cause of mortality and morbidity all over the world. According to a report of World Health Organization (WHO) in 2005, cardiovascular disease (CVD) caused 17.5 million (30%) of the 58 million deaths that occurred worldwide.[1] While the prevalence and mortality due to CHD is declining in the developed nations[2] the same cannot be held true for developing countries. There has been an alarming increase over the past two decades in the prevalence of CHD and cardiovascular mortality in India and other south Asian countries. India is going through an epidemiologic transition whereby the burden of communicable diseases have declined slowly, but that of non-communicable diseases (NCD) has risen rapidly, thus leading to a dual burden. There has been a 4-fold rise of CHD prevalence in India during the past 40 years. Current estimates from epidemiologic studies from various parts of the country indicate a prevalence of CHD to be between 7% and 13% in urban[3–5] and 2% and 7% in rural[6,7] populations. Epidemiologic studies have shown that there are at present over 30 million cases of CHD in this country. A study by Gajalakshmi et al during 1995–1997 showed that CVD deaths are the highest (38.6%) in urban Chennai.[8] Similar data are published by Joshi et al from Andhra Pradesh.[9] The Global Burden of Diseases Study reported that the disability-adjusted life years lost by CHD in India during 1990 was 5.6 million in men and 4.5 million in women; the projected figures for 2020 were 14.4 million and 7.7 million in men and women respectively.[10]

The burgeoning burden of CHD in India can be explained by the alarming rise in the prevalence of coronary risk factors like diabetes, hypertension, atherogenic dyslipidemia, smoking, central obesity and physical inactivity. Rapid urbanization and change in lifestyle that occurred during the past two decades have led to the growing burden of coronary risk factors in India. Previous studies conducted in migrant Indians were misinterpreted to indicate that conventional risk factors do not account for the high prevalence and premature occurrence of CHD among Indians[11]; they were thought to be genetically preordained to develop the disease. However, the large INTERHEART study which recruited significant number of Indian subjects found that the conventional risk factors accounted for most of the CHD burden.[12] The INTERHEART study was a large cross-sectional study of around 30,000 participants from 52 countries representing every inhabited continent. The specific aim was to assess the strength of association between various risk factors to myocardial infarction and to ascertain if this varies with geographic regions, age, sex or ethnicity. The secondary objective was to estimate the Population Attributable Risk (PAR) for risk factors and their combinations in the overall population and in various subgroups. The relation of smoking, history of hypertension or diabetes, waist/hip ratio, dietary patterns, physical activity, consumption of alcohol, blood apolipoproteins (Apo), and psychosocial factors to myocardial infarction was studied. The highest proportion of cases with first acute myocardial infarction at the age of 40 years or younger was in men from the Middle East (12.6%), Africa (10.9%), and south Asia (9.7%). The study showed that nine easily measured and potentially modifiable risk factors accounted for an overwhelmingly large (over 90%) proportion of the risk of an initial acute myocardial infarction. The effect of these risk factors was uniform in men and women, across regions and ethnic groups, making the study universally applicable. The effect of the risk factors was particularly striking in young men (PAR about 93%) and women (about 96%), indicating that most of the premature myocardial infarction was preventable. Psychosocial factors, abdominal obesity, diabetes, and

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hypertension were the next most important risk factors in men and women. The study showed that deaths due to Acute Myocardial Infarction (AMI) in south Asians occurred at 5–10 years earlier than western population; South Asian men encountering AMI were 5.6 year younger than women. Abnormal ApoB/ApoA-1 ratio and smoking were the most important risk factors. Low education level was associated with increased risk of AMI worldwide. Protective lifestyle factors such as leisure time physical activity and regular intake of fruits and vegetables were markedly lower among south Asians than western population, while harmful risk factors such as elevated ApoB/ApoA-1 ratio were higher in south Asians. South Asians have significantly higher population attributable risk associated with waist–hip ratio. Regular alcohol consumption was not protective for AMI in south Asians.

The INTERHEART study contributes significantly to our understanding of risk factors for coronary artery disease. It was the largest study in this field involving participants from different ethnic groups all over the world. However, certain caveats on the design and methodology are in order: firstly, the study was hospital-based from urban areas and the results may not be truly representing the populations at large; secondly, the measurements were done during the acute phase of myocardial infarction which would have affected the readings especially those of blood pressure, plasma glucose, lipids and even the measures of psychosocial stress. The study established that more than 90% of risk of first myocardial infarctions was attributable to easily measurable and modifiable risk factors and blew the myth that around half of the myocardial infarctions cannot be explained by known risk factors. It has also brought to light the importance of psychosocial stress in causing MI. A similar case–control study called INTERSTROKE[13] examined the association between risk factors and stroke. Between 2007 and 2009, 3000 patients with first stroke and same number of age and sex-matched controls from 22 countries were enrolled in the study. More than 80% of the cases and control were from low- and middle-income countries of Southeast Asia, India and Africa. As with the INTERHEART, ten risk factors accounted for most of the stroke events. Hypertension, smoking, obesity and physical inactivity accounted for 80% of stroke cases. Studies that compared rural with urban Indians or Indian migrants in the United Kingdom with their home country siblings or peers also clearly indicated that conventional risk factors like systolic blood pressure, plasma cholesterol, and overweight contributed to the excess risk of CHD in Indians moving to urban or migrant environments.[14]

India has one of the largest populations of diabetics (over 32 million) with a projected escalation to 57.2 million in 2025.[15] The prevalence of type2 diabetes in urban Indian adults has been reported to have increased from less than 3.0% in 1970 to about 12.0% in 2000.[16] On the basis of recent surveys, the Indian Council of Medical Research (ICMR) estimates the prevalence of diabetes in adults to be 3.8% in rural areas and 11.8% in urban areas. Similarly the count of hypertensives is expected to rise from 118 million in 2000 to 214 million in 2025.[17] Globalization – increasing openness to ideas, trade, finances and interconnectedness of countries – has had both beneficial and detrimental effects to the burden of non-communicable diseases and their risk factors. There have been great strides in the awareness and mass education on prevention of these diseases and availability of drugs for prevention and treatment of diseases as a result of global policy changes. However advertisements on internet and television have led to more aggressive marketing of tobacco products and unhealthy food items. Tobacco is the only consumer product that eventually kills half of its regular users. Transnational tobacco companies are aggressively exploiting the potential for growth in tobacco sales in the developing countries. Tobacco companies have consistently denied the adverse effects of tobacco, especially via passive smoking. Over the past decade the production and prevalence of use of tobacco products has increased by more than double in the developing world compared to 36% reduction in the developed world. India is the third largest country in the world in both tobacco production and consumption. Of the 1.1 billion smokers worldwide, 182 million live in India.[18] Replacement of a traditional diet rich in fruit and vegetables by a diet rich in calories provided by animal fats and low in complex carbohydrates, is happening in all but the poorest countries. Such changes will in general lead to increased rates of many non-communicable diseases, although not necessarily stroke rates, in countries previously protected by balanced and healthy diets.

The relationship between socio-economic status and coronary heart disease appear to evolve over time as the epidemic of CHD matures. In developed countries where the epidemic has been there for many decades, high incidence of CHD first occurred in high socio-economic group followed by a reversal of the trend.[19] Studies in India over the past half century have revealed a similar trend towards a progressive reversal of the social gradient for CHD. Although studies conducted from the 1960s to the early 1990 suggested a direct relationship between income and CHD risk, studies conducted in the last decade have reported an inverse relationship between education and/or income with prevalent or incident CHD.[20]

In the issue of the *Journal*, Sharma et al have reported the results of a survey of coronary risk factors among the administrative employees and their families of a major hospital in Delhi (2012;64:356–363). The investigators should be lauded for their effort to study and report the prevalence of cardiovascular risk factors among employees of a large hospital. The methodology is clearly laid out and the measurements and tools have been carefully standardized. The study reports a relatively high prevalence of coronary risk factors among a sample of relatively young population. The prevalence of hypertension, hypercholesterolemia, obesity, physical inactivity, poor intake of fruit and vegetables has been particularly high. However, the study is limited by small sample size and the method of sampling. The paper fails to mention the size and characteristics of the total population under study, and as a result meaningful inferences are hard to make. However, the study underlines the fact that despite proximity to health care and financial support for health-related expenditure, the prevalence of risk factors for coronary artery disease remains high. A similar study by Prabhakaran et al in a selected relatively young male population in an industrial setting from north India also revealed high

prevalence of coronary risk factors.[21] In a cross-sectional survey of all employees in the 20–59 years' age group in an organized sector industry, a total of 2935 employees (344 women and 2591 men) were enrolled in the survey. One-third of the participants had hypertension and 15% had diabetes; 36% were smokers. Even in the youngest between 20 and 29 years of age, only a quarter had normal blood pressure, half had normal glucose tolerance, more than half had dyslipidemia and one-fifth had at least two coronary risk factors. Awareness of diabetes and hypertension was poor, and even among the aware, control was suboptimal. The study emphasized the opportunity for preventive interventions among industrial population which will eventually lead to a healthy workforce and reduction in health care expenditure.

Over the past two decades there have been several studies on the prevalence of cardiovascular risk factors from India (Table 1). In a field survey conducted in Kerala's rural population in 1993, Raman Kutty et al found definite CHD in 1.4% and possible in 7.4%; the prevalence of major risk factors like hypertension, smoking, diabetes and obesity was 17.9%, 21.9%, 4% and 5.5% respectively.[22] Chadha et al performed a community-based survey of coronary heart disease and its risk factors in Delhi and its adjoining areas.[23] Over 13,134 men and women from Delhi and 1732 from rural areas were participated. The overall prevalence of coronary heart disease among adults based on the clinical and ECG criteria was estimated as 9.7% and 2.7% in the urban and rural populations, respectively. There was highly significantly higher prevalence in the major risk factors in urban versus rural population.

Singh et al performed a population survey of CHD and risk factors in a rural and urban setting of Moradabad in 1997.[24] A sample of 3575 subjects between ages 25 and 64 was enrolled in the survey. Overall prevalence of CHD was 9% and 3.3% in urban and rural populations respectively.

Gupta et al conducted a cross-sectional survey of 1123 subjects in an urban population of Jaipur in 2002 to evaluate the prevalence of coronary artery disease and risk factors.[25] The overall prevalence of CAD was 6.2% in men and 10.8% in women. The highest prevalence of risk factors included hypertension (36.9%), tobacco use (23.9%), obesity (63%) and hypercholesterolemia (39.1%). Diabetes was prevalent in 12.2% of the cases. Thus the study highlighted the presence of high prevalence of CAD and risk factors in the sample. Compared to a previous study in the same population in early 1900, the prevalence of diabetes, hypertension and dyslipidemia had increased significantly although the prevalence of CAD, smoking or physical activity had not changed.

In a recent large study from Kerala, Thankappan et al demonstrated a high prevalence of risk factors comparable to the Unites States.[26] The study provided valuable insights into the prevalence, awareness and control of various risk factors for chronic non-communicable diseases. A sample of 7449 men and women from rural, urban and slum background were included in the survey. Anthropometric and behavioural characteristics, blood pressure, serum lipid levels and fasting blood glucose were analyzed. The study underlined the alarmingly low level of awareness, treatment and control of hypertension and diabetes in the sample. Only a third of the individuals were aware of their hypertension and only a quarter were treated; of the treated, one-third had adequate control. Similar trends were noted in diabetes. The prevalence of smoking was 42% which was double that in the United States but lower than Indonesia[27] and Vietnam.[28] High blood pressure was observed in nearly 30% of individuals evaluated, comparable to[29] the prevalence in the United States; diabetes was 50% higher.[30] Mean cholesterol levels were similar but mean HDL levels were lower.[31] In terms of behavioural risk factors, a fifth of the sample used tobacco products, and a tenth consumed alcohol, and two-fifths consumed a diet low in fruit and vegetable; but physical inactivity was uncommon. Twenty-five percent of the sample was overweight and 34% had abdominal obesity using the threshold used for developed countries. These were lower than the corresponding figures for the United States.

In 2011, a large population survey from rural and urban samples of three geographical regions of Kerala was conducted.[32] Data were collected from 5193 men and women between the ages 20 and 79 years, according to the WHO STEPS method. The prevalence of coronary artery disease and risk factors were collected. The study showed an alarming increase in the prevalence of CAD and most of the major risk factors. The study showed that the prevalence of

Table 1 – Prevalence of CAD and risk factors from various large Indian studies.

Study	Period	N	Setting	Prevalence %				
				CHD	Major risk factors			
					HTN	DM	High cholesterol	Smoking
Raman Kutty et al	1993	1253	R	7	18.8	4[a]	–	21.9
Chadha et al	1997	14.886	U/R	U 9.7/R 2.7	10.6	1.5[a]	43.7	18.1
Singh et al	1997	3575	U/R	U 9/R 3.3	23.4	4.5	22	19.7
Gupta et al	2002	1123	U	8.2	36.9	12.2	39.1	23.9
Thankappan et al	2010	7449	U/R	–	28.8	14.8	54.1	42
CSI Kerala CRP study	2011	5193	U/R	15.7	39	21	23	31

U = urban; R = rural; CHD = Coronary heart disease; HTN = Hypertension; DM = Diabetes mellitus; CSI Kerala CRP study: Cardiological Society of India Kerala Chapter Coronary Artery Disease and its Risk Factors Prevalence study.
a Diagnosed by history only.

CAD in Kerala has risen over the past two decades, mainly driven by the rise in coronary risk factors. There was a high prevalence of CAD among young individuals (2%) as compared to western data (1.2%). Contrary to most of the previous Indian data, there was no difference between urban (15.1%) and rural (16.2%) prevalence of CAD in this study.

All evidence points to the disturbing fact that the country is heading to an epidemic of CHD and its risk factors. Unless urgent measures are taken to curb the escalating risk factors, the incidence of CHD will grow beyond control. Measures to bring down the incidence of risk factors will go a long way towards the control of CHD epidemic in India.

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